Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

Claims 1 – 38 (canceled)

Claim 39 (currently amended) A method for determining forces to be applied to a user through a

haptic interface, the method comprising the steps of:

generating a representation of a virtual object;

determining a haptic interface location in response to a ~~location~~position of a user;

determining a fiducial object location on the surface of the virtual object; and

calculating a force to be applied to the user in response to ~~the~~said haptic interface location

and ~~the~~said fiducial object location.

Claim 40 (previously presented) The method of claim 39, wherein the haptic interface is

represented by a single point and the fiducial object is represented by a single point.

Claim 41 (previously presented) The method of claim 39, wherein the fiducial object is

represented as a three dimensional object.

Claim 42 (currently amended) The method of claim 41, wherein ~~the~~said three dimensional object

is approximated by a series of points.

Claim 43 (currently amended) The method of claim 39, wherein ~~the~~said fiducial object is

represented as a three dimensional object, ~~the~~said three dimensional object is

approximated by a series of points, and the haptic interface location is a single point.

Claim 44 (previously presented) The method of claim 39, wherein the step of determining the

fiducial object location comprises the steps of:

generating a representation of a virtual object within a computer; and

computing the fiducial object location, such that the distance between the fiducial object

location and the haptic interface location is minimized while maintaining that the fiducial

object not pass through the virtual object.

Claim 45 (previously presented) The method of claim 44, wherein the geometric representation

of the virtual object is generated from a standard computer graphic file format.

Claim 46 (currently amended) The method of claim 44, further comprising the step of

calculating a reaction force to send to the user, wherein ~~the~~said reaction force depends on

a distance between the haptic interface location and the fiducial object location.

Claim 47 (currently amended) The method of claim 46, wherein ~~the~~said reaction force is

proportional to ~~the~~said distance.

Claim 48 (currently amended) The method of claim 46, wherein the step of calculating the

reaction force involves calculating a component of ~~the~~said reaction force which depends

on a difference in velocity between the haptic interface location and the fiducial object

location.

Claim 49 (currently amended) The method of claim 48, wherein ~~the~~said component of ~~the~~said

reaction force which depends on the difference in velocity between the haptic interface

location and the fiducial object location is proportional to ~~the~~said difference in velocity.

Claim 50 (previously presented) The method of claim 44, further comprising the step of

displaying on a display in a location relative to the virtual object location.

Claim 51 (currently amended) The method of claim 50, wherein ~~the~~said fiducial object location

is different from ~~the~~said haptic interface location.

Claim 52 (currently amended) The method of claim 50, wherein ~~the~~said fiducial object is
substantially co-located with ~~the~~said haptic interface location.

Claim 53 (previously presented) The method of claim 44, wherein the method is performed
iteratively until a valid fiducial object location is found.

Claim 54 (previously presented) The method of claim 53, wherein multiple surfaces of at least
one virtual object are considered in calculating a valid fiducial object location.

Claim 55 (previously presented) The method of claim 44, wherein the virtual object deforms in
response to force applied to the virtual object by the user.

Claim 56 (previously presented) The method of claim 55, wherein the applied force comprises at
least one of a damping force, a stiffness force, and a friction force.

Claim 57 (previously presented) The method of claim 55, wherein the applied force comprises at
least two of a damping force, a stiffness force, and a friction force.

Claim 58 (previously presented) The method of claim 55, wherein the applied force comprises a
damping force, a stiffness force, and a friction force.

Claim 59 (canceled)

Claim 60 (currently amended) A system for determining force to be applied to a user through a
haptic interface, the system comprising:
    a modeling module that generates a representation of a virtual object;
    a computation module that determines a haptic interface location in response to a
    location~~position~~ of a user;
    a locating module that determines a fiducial object location on the surface of the virtual
    object; and

a force computation module that calculates a force to be applied to the user in response to the haptic interface location and the fiducial object location.

Claim 61 (previously presented) The system of claim 60, further comprising:

a simulation module that computes the fiducial object location such that distance between the fiducial object location and the haptic interface location is minimized while maintaining a condition that the fiducial object not pass through the virtual object.

Claim 62 (previously presented) The system of claim 61, further comprising a display module that displays a representation of the fiducial object on a display in a location relative to the virtual object location.

Claim 63 (previously presented) The system of claim 60, wherein the haptic interface is represented by a single point and the fiducial object is represented by a single point.

Claim 64 (previously presented) The system of claim 60, wherein the fiducial object is represented as a three dimensional object.

Claim 65 (previously presented) The system of claim 64, wherein the three dimensional object is approximated by a series of points.

Claim 66 (previously presented) The system of claim 60, wherein the fiducial object is represented as a three dimensional object, the three dimensional object is approximated by a series of points, and the haptic interface location is a single point.

Claim 67 (previously presented) The system of claim 60, further comprising:

a generation module that generates a representation of a virtual object within a computer; and

a displacement module that computes the fiducial object location such that distance between the fiducial object location and the haptic interface location is minimized while maintaining a condition that the fiducial object not pass through the virtual object.

Claim 68 (previously presented) The system of claim 60, wherein a geometric representation of the virtual object is generated from a standard computer graphic file format.

Claim 69 (previously presented) The system of claim 60, further comprising a module that calculates a reaction force to apply to the user wherein the reaction force depends on distance between the haptic interface location and the fiducial object location.

Claim 70 (previously presented) The system of claim 69, wherein the reaction force is proportional to the distance.

Claim 71 (previously presented) The system of claim 69, wherein the module that calculates the reaction force calculates a component of the reaction force which depends on a difference in velocity between the haptic interface location and the fiducial object location.

Claim 72 (previously presented) The system of claim 71, wherein the component of the reaction force which depends on the difference in velocity between the haptic interface location and the fiducial object location is proportional to the difference in velocity.

Claim 73 (previously presented) The system of claim 60, further comprising a display for displaying on the display in a location relative to the virtual object location.

Claim 74 (previously presented) The system of claim 73, wherein the fiducial object location is different from the haptic interface location.

Claim 75 (previously presented) The system of claim 73, wherein the fiducial object is substantially co-located with the haptic interface location.

Claim 76 (previously presented) The system of claim 60, further comprising a controller module that causes the locating module to iterate until a valid fiducial object location is found.

Claim 77 (previously presented) The system of claim 76, wherein the locating module considers multiple surfaces of one or more virtual objects in calculating a valid fiducial object location.

Claim 78 (previously presented) The system of claim 60, wherein the virtual object is adapted to deform in response to force applied to the virtual object by the user.

Claim 79 (previously presented) The system of claim 78, wherein the applied force comprises at least one of a damping force, a stiffness force, and a friction force.

Claim 80 (previously presented) The system of claim 78, wherein the applied force comprises at least two of a damping force, a stiffness force, and a friction force.

Claim 81 (previously presented) The system of claim 78, wherein the applied force comprises a damping force, a stiffness force, and a friction force.

Claim 82 (currently amended) A method for determining forces to be applied to a user through a haptic interface, thesaid method comprising the steps of:

   (a)   generating a representation of an object in graphic space by defining thesaid object as a mesh of planar surfaces, each of thesaid planar surfaces comprising nodes;

   (b)   sensing a locationposition of a user in real space;

   (c)   determining a haptic interface location in graphic space in response to thesaid locationposition of thesaid user in real space;

   (d)   determining a fiducial object location on the surface of the object in graphic space;

    (e)   calculating a stiffness force to be applied to ~~the~~said user in real space in response to ~~the~~said haptic interface location and ~~the~~said fiducial object location in graphic space; and

    (f)   calculating a magnitude of a damping force to be applied to ~~the~~said user in real space in response to ~~the~~said haptic interface location and ~~the~~said fiducial object location in graphic space, further comprising the steps of:

        (i)   associating a damping coefficient with each of ~~the~~said nodes of each of ~~the~~said planar surface<u>s</u>;

        (ii)   determining on which of ~~the~~said planar surfaces ~~the~~said fiducial object is located; and

        (iii)   computing a damping coefficient of ~~the~~said fiducial object location by interpolating ~~the~~said damping coefficients associated with ~~the~~said nodes of each of ~~the~~said planar surfaces on which ~~the~~said fiducial object is located.

Claim 83 (currently amended) A method for determining forces to be applied to a user through a haptic interface, ~~the~~said method comprising the steps of:

    (a)   generating a representation of an object in graphic space by defining ~~the~~said object as a mesh of planar surfaces, each of ~~the~~said planar surfaces comprising nodes;

    (b)   sensing a <u>location</u>~~position~~ of a user in real space;

    (c)   determining a haptic interface location in graphic space in response to ~~the~~said <u>location</u>~~position~~ of ~~the~~said user in real space;

    (d)   determining a fiducial object location on the surface of the object in graphic space;

    (e)   calculating a stiffness force to be applied to ~~the~~said user in real space in response to ~~the~~said haptic interface location and ~~the~~said fiducial object location in graphic space; and

(f)   calculating a direction of a damping force to be applied to thesaid user in real space in response to thesaid haptic interface location and thesaid fiducial object location in graphic space, further comprising the steps of:

    (i)   associating a surface normal with each of thesaid nodes of each of thesaid planar surfaces;

    (ii)   determining on which of thesaid planar surfaces thesaid fiducial object is located; and

    (iii)   computing a surface normal for thesaid fiducial object location by interpolating thesaid surface normals associated with thesaid nodes of each of thesaid planar surfaces on which thesaid fiducial object is located.